SINAN KARAHAN, Ph.D.

Principal Robotics Scientist | State Estimation & Control for Humanoid and Mobile Robots

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SUMMARY

Robotics scientist building the state estimation, sensor fusion, and control that humanoid and mobile robots need to perceive their own motion and act safely. Proven in production: shipped the first production 9-axis Kalman-filter sensor fusion on iPhone, real-time fusion and calibration on InvenSense IMU chips, and the localization stack on Gatik's autonomous trucks. Robotics depth includes force-controlled path planning for an NIH-funded 6-DOF physical-therapy robot, surgical-catheter kinematics at Hansen Medical, industrial-manipulator control at Carbon Robotics, and graduate robotics teaching. Hands-on with Bayesian estimation (EKF, UKF, particle filters), sensor calibration, robot kinematics and dynamics, trajectory planning and model-based control, in C++ on ROS/ROS 2 and embedded targets.

TECHNICAL EXPERTISE

- Estimation & sensor fusion: Kalman filters (standard, extended, and unscented) and particle filters; Bayesian estimation; loosely- and tightly-coupled GNSS/INS; map matching; attitude and contact-state estimation; observability and fault detection
- Sensing & calibration: IMU, GNSS, LiDAR, camera, radar, wheel odometry, magnetometer, force/torque and touch sensors; bias, scale, misalignment, and temperature calibration; sensor characterization
- Robotics & control: robot kinematics and dynamics, trajectory and path planning, model predictive control, force-based control, GNC and attitude control
- Software & validation: C/C++, Python, MATLAB/Simulink, ROS/ROS 2, Linux, embedded real-time systems, simulation (CarMaker, CarSim, CARLA), hardware-in-the-loop, Monte Carlo analysis, ISO 26262 functional safety
- Machine learning: random-forest and classical ML for sensor-based detection and activity recognition

SELECTED TECHNICAL ACHIEVEMENTS

- Apple: Shipped the first production 9-axis Kalman-filter sensor fusion in iPhone Core Motion (iPhone 4 generation), along with compass calibration, delivering 3-D device orientation to millions of devices.
- Gatik: Built the production localization filter for autonomous trucks, reaching 2 cm accuracy with RTK GNSS and 10 cm with degraded or no GNSS by fusing LiDAR, camera, and wheel odometry, with out-of-sequence fusion for delayed measurements.
- InvenSense: Invented embedded calibration algorithms that run in real time on IMU silicon, improving accuracy and speed while reducing power consumption and memory footprint; 4 issued U.S. patents across InvenSense and TDK InvenSense.
- Robotics: Designed force-controlled path planning for an NIH-funded 6-DOF physical-therapy robot and designed the kinematics for a robotic surgical catheter at Hansen Medical.
- Space: Selected, characterized and calibrated the IMU, magnetometer and GNSS suite for a commercial communications satellite.

PROFESSIONAL EXPERIENCE

Gatik — Santa Clara, CA **Sep 2024–Oct 2026**
Technical Lead, Mapping and Localization

- Owned localization for Gatik's autonomous trucks: navigation software fusing GNSS, IMU, LiDAR, camera and wheel odometry.
- Met localization accuracy targets of 2 cm with RTK GNSS and 10 cm with degraded or no GNSS by adding LiDAR, camera, and wheel-odometry measurements to the production navigation Kalman filter with lane-level map matching; code ran daily on the commercial truck fleet.
- Implemented out-of-sequence measurement fusion for delayed LiDAR and camera signals, improving localization accuracy.
- Developed extended and unscented Kalman filters, estimation algorithms, and sensor-calibration methods for the production autonomy stack.
- Built ROS/ROS 2 data pipelines to characterize and validate fusion, localization and map-matching performance.

Karahan Consulting — Menlo Park, CA **Oct 2023–Sep 2024**
President

- Advised clients on sensor fusion, calibration, estimation, GNC, control, AR/VR, and autonomous-driving systems.

E-Space — Los Gatos, CA **Aug 2022–Aug 2023**
Director, GNC Sensors & Actuators (Principal-level IC)

- Owned the GNC sensor and actuator roadmap and algorithms for a commercial communications satellite.
- Selected, tested and deployed IMU, magnetometer and GNSS sensors; led its characterization and performance validation.
- Developed attitude-control and estimation algorithms and sensor bias and temperature calibration methods.

TDK InvenSense — San Jose, CA **Apr 2019–Aug 2022**
Director, Algorithms

- Led a 12-engineer Ph.D./M.S. algorithm team shipping sensor fusion, calibration, filtering and activity-detection algorithms for handhelds, wearables, robots and industrial sensors.
- Delivered a random-forest acoustic/vibration classifier for Industry 4.0 wafer dicing that doubled defect detection; co-invented U.S. Patent 11,680,823 on temperature-driven sensor calibration for mobile-robot navigation.

XPeng Motors (XMotors.ai) — Mountain View, CA — **Feb 2018–Mar 2019**
Principal Research Scientist, Autonomous Driving

- Technical lead for a 20-engineer team covering sensor fusion, perception, path planning, navigation and control; ran vehicle testing on AutonomouStuff platforms.
- Developed loosely- and tightly-coupled GNSS-IMU Kalman filters with map matching and radar/LiDAR/camera fusion for perception.

SF Motors (SERES) — Sunnyvale, CA — **May 2017–Feb 2018**
Lead Research Scientist, Autonomous Driving

- Led sensor fusion, perception and localization using IMU, camera, radar, LiDAR and map data; tested on prototype vehicles.
- Developed MPC-based path planning for lane change and lane following; built and evaluated simulation using CarMaker, CarSim, and CARLA.
- Completed ISO 26262 functional-safety certification.

Carbon Robotics — San Francisco, CA — **Jan 2017–May 2017**
Director of Robotics and Algorithms

- Developed kinematics, dynamics, trajectory planning, control and vision algorithms for an articulated industrial robot; modeled and simulated in ROS with OpenCV.

Startup Engagements — Palo Alto / San Jose, CA — **Apr 2016–Jan 2017**
Algorithm Lead

- Nixie: Developed camera/IMU navigation and hover-stabilization Kalman filters for a quadcopter, deployed on flight hardware.
- NextInput: Developed nonlinear force-touch response-correction algorithms in C++, deployed on mobile hardware.

InvenSense — San Jose, CA — **Oct 2012–Apr 2016**
Principal Engineer and Director, Advanced Algorithms

- Developed 6- and 9-axis Kalman-filter fusion and calibration algorithms that run in real time on InvenSense IMU chips, shipped across multiple product lines.
- Built indoor positioning with particle filters, map matching, Wi-Fi/Bluetooth beacons, pedestrian dead reckoning and GPS.
- Filed patents on sensor calibration, orientation prediction, and low-power attitude generation; three issued as U.S. patents.

Apple — Cupertino, CA — **Nov 2010–Jan 2012**
Research Scientist / Motion Algorithms Lead

- Developed in C++ on iOS and shipped the first production 9-axis (gyroscope, accelerometer, magnetometer) Kalman-filter fusion on iPhone.
- Developed compass calibration and Core Motion / Core Location features for orientation, sensor data and calibration.

EARLIER CAREER

Principal Algorithm Scientist, Sensor Platforms (shipped Unscented Kalman-filter fusion in a handheld air mouse) · Principal Research Scientist, NASA Ames Research Center (aerospace optimization) · Robotics Engineer, Hansen Medical (surgical catheter robot kinematics) · Spacecraft Engineer, Octant Technologies · Robotics Software Engineer, The Motion Factory (character kinematics and dynamics) · Principal Algorithm Engineer, Sensys Instruments / Therma-Wave · Simulation Group Leader, Integrated Systems

EDUCATION

- Ph.D., Mechanical Engineering, University of California, Davis — nonlinear systems, control theory, estimation, robot kinematics and dynamics, optimization. Dissertation work: force-controlled path planning and isotonic/isokinetic control for an NIH-funded 6-DOF physical-therapy robot.
- M.S., Mechanical Engineering, University of California, Davis
- B.S., Mechanical Engineering, Middle East Technical University

TEACHING, PATENTS & PROFESSIONAL ACTIVITIES

- Adjunct Professor, Santa Clara University: taught a three-quarter graduate robotics sequence (kinematics, dynamics, control, path planning).
- 4 issued U.S. patents and 9 U.S. patent filings in sensor fusion, attitude estimation and calibration (Apple, InvenSense, TDK InvenSense).
- Industrial Vice Chair, IFAC Symposium on Nonlinear Control Systems (NOLCOS 2016).
- Board of Advisors: TuringSense (2014-2016); Lumo Body Tech (2015-2016).
- Member: IEEE, ASME, Sigma Xi.